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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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In the Matter of

Allocation of Spectrum in the
5 GHz Band to Establish a Wireless
Component of the National Information
Infrastructure

In the Matter of

Petition for Rulemaking to Allocate the
5.1 - 5.35 GHz Band and Adopt Service
Rules for a Shared Unlicensed Personal
Radio Network

)
) RM No. 8653
)

) ET Docket No. 96-102
)

) RM No. 8648
)
)

COMMENTS OF THE NATIONAL SCIENCE FOUNDATION
WIRELESS FIELD TEST FOR EDUCATION PROJECT

As the Principal Investigator of a series of field tests of wireless data communications for education, with emphasis on the examination of the value of shared no-license Part 15 devices, I file these comments on behalf of the technical staff of this project, which represent no commercial manufacturer or service, nor government agency, (and not the NSF itself) but only the considered judgements of independent investigators evaluating the potential for US education of wireless data communications in the context of the broadest public policy interests. This project's status, progress, and findings can be accessed at <http://wireless.oldcolo.com>

We oppose the Apple Computer NII Band proposal (RM-8653) as originally submitted for a new, non-spread spectrum shared wireless service of 150Mhz between 5.725 and 5.875Ghz, at 1 watt of power. Thus we agree with the FCC's not proposing to create such a new service.

We support the WINForum (RM-8648) request for low power SUPERNET service of no more than -10 dBW power across 200Mhz in the 5.15 - 5.15Ghz bands only, as proposed by the FCC in the NPRM.

We oppose the FCC NPRM proposed extension of the WINForum request, for an additional 150Mhz of bandwidth into the 5.725 - 5.875Ghz band range.

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We strongly feel that the public use objectives originally sought by the Apple Computer Petition for community networking by longer range, higher power shared-spectrum radio rules, are of paramount public policy importance. In fact it appears Congress agrees with us, when it mandated the FCC in the 1996 Federal Telecommunications Act, after the above Petitions were filed, to provide for advanced, affordable, telecommunications services to all citizens, and in particular schools and libraries.

However the failure of Apple Computer to provide sufficient or convincing technical justifications, while excluding spread spectrum techniques, for sharing spectrum in the 5.725-5.875 bands without interference with either existing Part 15 services in the same bands, or their own radios once any significant density of radios are deployed in the same area, leads us to conclude that their proposal is unworkable. And will, if approved, in fact, threaten to degrade the ability of radios designed to operate, spread spectrum at 1 watt of power, in the 125Mhz of spectrum between 5.725 and 5.850 (Part 15.247 rules) to achieve the same objectives.

We see no objection to the WINForum proposal for new low power service in the 5.15 - 5.35 GHz range. This will permit much faster wireless LANs to be designed for in-building use, meeting a growing need. Though we are not convinced it is either aimed at, nor will as significant for schools or libraries as its proponents claim when justifying it.

Additionally, we do not see that the meeting of that new need for short range, low power, high speed, in-building wireless connections, will, of and by itself, meet the far greater need for longer range, between building, across towns, and between data points of presence, shared no-license data communications. The 200 Mhz being allocated in the 5.15 - 5.35 GHz bands appear to be sufficient to permit the design and operation of new classes of more advanced radios. Adding an additional 150 Mhz to that allocation appears, to us, to be extending capabilities only 'at the margin' and is not centrally required. And it will be undesirable if it threatens to degrade the performance of radios providing other services.

Thus we oppose the FCC's own proposal of extending the SUPERNET service originally requested by WINForum, from the 5.15 - 5.35 GHz to the 5.725 - 5.875 bands, even at maximum transmitter power of only -10 dBW (approximately 50 meters range) on the grounds that this would cause interference with already permitted Part 15.247 Rules radios, which radios can perform data transmission tasks under current rules for 'community networking' purposes that the Apple Computer proposal purports to do. Permitting the FCC NPRM proposed low power services in the same 'upper' NII/SUPENET bands could seriously degrade the ability of services transmitting point to point under Part 15.247 rules at longer ranges between buildings - such as

schools of a district, or across cities, or between rural towns and the closest points of presence of other services such as the Internet. It can also interfere with Part 15.247 in-building LAN devices which are already permitted.

In other words, if a school or institution were using low power high speed in-building LANs in the 5.725 - 5.850 bands, and a Part 15.247, 1 watt radio, with directional antenna operating at a distance - as measured in kilometers, attempted to transmit to a receiving antenna in the same building (or on the same signal pathway), the interference could easily be sufficient to prevent communications entirely, if not simply degrade it.

Since radios operating under Part 15.247, in 125 Mhz of bandwidth at 1 watt are capable of providing such shared spectrum service at ranges at least as far as the Apple Computer proposed 15km, without any new service such as Apple Computer's proposed service, further rulemaking by the FCC should not encourage degradation of that existing capability.

While the Apple Computer proposal is rationalized in terms of 'community networking,' - a general public telecommunications goal which can be fully justified - it is a rather difficult concept to quantify in terms of spectrum allocation and management - range, power, and sustainable bandwidth. But it is not difficult to quantify the demonstrable needs - including those required right now - for extending no-license wireless services to US educational institutions. And since schools and colleges are invariably located, and whose areas serve where 'people' (who make up 'communities' live) if new rules support shared spectrum, no-license wireless services that support 'education' in 'communities' then we hold that the greater part of what Apple Computer referred to as 'community networking' needs will be met also. So the remainder of this analyses is focused on the impact of the existence or denial of long range no license communications on educational institutions.

Our studies of the real and comprehensive needs of typical educational institutions - from K to 12, community and junior colleges, and higher education campuses, in both rural and urban areas, for shared spectrum, no license data communications clearly indicates that the needs are in the following priority and order:

1. Connections between the dispersed building of a school district or college campus. Usually high bandwidth, but moderate distances - 1 to 10 miles. Greatest need because of redundant recurring costs if those 'local loop' needs are only served by commercial telephone, or coming cable company services.

2. Connections between the hub building of a district and the nearest point of presence. Up to 25 miles. A major problem for rural communities, small towns, and sprawling suburbs.

3. Connections at higher than POTS data rates from the homes of students and teachers. Bandwidth's above 56ks at ranges to 20

miles. A need - multi-media bandwidth - that will only grow in the future, because of the already inadequacy of 28.8bps modem telephone service bandwidths.

4. Internal building data communications. Least need, because of wide array of alternatives - from wired (no recurring cost) lans, and wireless LANs operating under Part 15 current rules.

There are 16,438 separate public school districts, 84,175 public schools, over 23,000 private schools, over 4,000 colleges and universities, and 15,679 public libraries distributed throughout all inhabited 'communities' of the United States, all of which require at least connectivity bandwidth between 56kbs and 2mbps costing from \$100 a month each link to \$1,000 or more by conventional commercial wired local connections. If these institutions lack the alternative of being able to connect up their networks by other than commercial charge wired, cable, or radio 'services' - such as by purchasing high bandwidth, long (25 mile) range, reliable, secure, no-license radios ranging today from \$750 to \$8,000 on a one time basis, the effect will be to continue to retard the extension of advanced telecommunications services to and within all communities of the United States.

We take serious note that the deregulatory aspects of the new Telecommunications Act are predicated greatly on the idea of promoting true 'competition' between telecommunications vendors. We have observed that, particularly in rural areas, but also in urban areas where there is no, and will not be for some time to come, any alternative local loop wired infrastructure, that schools, libraries, and colleges have no practical alternative if they want to get Internet connectivity than to retain the services of local loop - telephone company - providers. At whatever price is offered. Practically speaking, there 'is no' competition. However the ability of a school, library, or college to buy radios from competitive vendors which can provide the same data speeds across cities, or between towns up to the 25 mile range, without license on a shared spectrum basis, and link the institution to a point of presence, or link the buildings of a school, for example, to each other. That is real competition for local loop providers.

Our studies show that the difference in cost to the above type public institutions for connectivity to the Internet alone, between buying commercial services, and buying radios with comparable bandwidth capabilities, over 10 years, can amount to a 5 to 10 to 1 cost ratio of commercial services versus no-license radio connections for the local portion of the network costs. In one specific current case in a rural area of Colorado, with 30 communities and 14 separate school districts, the difference between extending T-1 data links from a college in the one central town to the 14 districts by US West tariffed telephone circuits, and extending 25 mile spread spectrum radio T-1 services to the same school districts is \$1.2 million (telco) versus \$134,000 (wireless) over the first 10 year period. That is an enormous practical cost

difference to those tax supported rural school districts.

Appeals to commercial service providers to offer, over a short term, 'free' Internet connectivity is not a long term, scalable, or sustainable solution to this problem. Nor will be the prospect of all wireless services being a commercial cost service. In fact the urging by the FCC - which is currently observable - of such 'free' connectivity is anti-competitive. First of all, only the larger Internet providers would be in position to offer such free connectivity services for any length of time. And the genuine competition provided by no-licence radio vendors would be further inhibited. At the end of two year free Internet connectivity services, institutions would still be faced with buying market priced connectivity, while no-licence radio services do not face that day of reckoning. We have specifically observed in rural areas which have been past recipients of connectivity 'grants' that when the grant money runs out, the service has often been dropped by schools. (US West \$250,000 grant to schools of the San Luis Valley of Colorado for 'compressed video' services. When the grant funds ran out in the early 90's, the school districts could not justify the \$7,000 per year T-1 local loop costs, so all connectivity was severed)

But, while the proposed WINForum SUPERNET low power services will provide some useful new services to both education, thus communities, and while the Apple Computer proposal can do nothing for the NII service that is not already permitted under Part 15.247 rules, neither one in these Petitions really addresses the public needs for adequate shared spectrum, no-license connectivity. They are marginal improvements at best.

While we fully understand, that under FCC formal procedures for rule making, this is only the rulemaking response to Petitions submitted, we would like to make it clear that we feel that the resolution of RM-8648 and RM-8653 with any of the proposed combinations, in no way seriously satisfies the shared no-license spectrum needs of either US communities, or education, for alternatives to commercial radio. telephone, or cable data 'services,' which needs can clearly be technologically and economically met by much bolder and visionary rules which encourage US manufacturers to make, and profit from, new generations of radios designed to operate in the no-license spectra without the necessity of justifying them by providing charged services.

The central issue of potential interference between no-license radios designed under FCC rules, and with current technologies, has been dealt with decisively in theoretical studies and simulations. The July, 1995 Doctoral Thesis by Timothy Shepard, MIT "Decentralized Channel Management in Scalable Multihop Spread-Spectrum Packet Radio Networks" conclusively demonstrates that 'billions' of radio nodes can now be automatically managed in the same electromagnetic space.

Ruled right, with sufficiently wide bandwidth, minimum standards for process gain in the radios and correspondingly much higher efficiency in data throughput as well as tolerance for background as well as other-radio noise, the issue of interference potential for many bands of spectrum could become a practical non-issue for whole segments of the electromagnetic spectrum.

Thus we do not believe that '... market forces under a licencing scheme' for longer range radios '...would significantly increase spectrum efficiency' simply because it is not necessary if the rules for new radio services are right. So it is totally outdated thinking to continue to use the old paradigm of 'value of spectrum' as if there is an absolute scarcity and suggest solving it by auction to the highest bidders, who would get exclusive use of its bands. A totally new paradigm is needed, even if only exercised in limited bands for starters. And the 'shared spectrum' no-license arena is where that paradigm should be born.

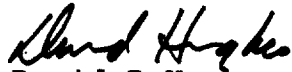
CONCLUSIONS AND RECOMMENDATIONS

We oppose the Apple Computer NII Band proposal (RM-8653) as originally submitted for a new, non-spread spectrum shared wireless service of 150Mhz between 5.725 and 5.875Ghz, at 1 watt of power. Thus we agree with the FCC's not proposing to create such a new service.

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We strongly recommend that the FCC, therefore, as part of the decision on these pending docket matters, acknowledge the inadequacy of any rules made under this Rule Making action, in light of current and project technological possibilities, and resolve to commence work on its own initiative - by issuance of a new Notice of Inquiry, to achieve the aims of the partial vision of better spectrum-based digital services represented by these timid and inadequate Petition proposals by Apple Computer and WINForum. And to do so by a far different and far more promising, as well as interference problem-solving means now wholly made possible by the proper coupling of technological means and supporting rules.



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